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Original Research Article

Prevalence and determinants of low birth weight in Rohilkhand region, Uttar Pradesh

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ABSTRACT

Background: Weight of a newborn during delivery is a critical determinant of his health and a key element in determining the infant's ability to survive, grow physically and mentally. Additionally, it is a sign of the mother's well-being. The present study was done to study the prevalence of low birth weight , to describe the factors affecting low birth weight and to suggest remedial measures for prevention of low birth weight.
Methods: A cross sectional study was carried out in a community health centre attached with Rajshree Medical Research Institute among 227 mothers for one year. Analysis was done for estimating prevalence of low birth weight and its association with socio-demographic features, maternal clinical characteristics and newborn characteristics. Suitable research analysis was done.
Results: 20.3% newborns delivered were low birth weight. Factors which were found to have significant association with low birth weight are maternal age ($p<0.05$), maternal education ($p<0.05$), work done during pregnancy ($p<0.05$), gestational length ($p<0.001$), iron and folic acid (IFA) prophylaxis ($p<0.01$) and sex of baby ($p<0.01$).
Conclusions: Our study indicates that maternal age, maternal education, gestational length, IFA prophylaxis, work done during pregnancy and sex of baby are significant determinants of low birth weight. These findings highlight the importance of maternal health and prenatal care interventions in reducing the incidence of low birth weight.

Keywords: Determinants, IFA prophylaxis, Low birth weight, Maternal health, Prevalence

INTRODUCTION

Weight of a newborn during delivery is a critical determinant of his health and a key element in determining the infant's ability to survive, grow physically and mentally. Additionally, it is a sign of the mother's well-being.[1] Low birth weight is described by the World Health Organization (WHO) as an infant weighing less than 2500 grams (gms) (up to a maximum of 2499 grams) at birth, regardless of gestational age. In 1976, The World Health Assembly, 29th session accepted this low birth weight norm.[2]

Low birth weight is regarded to have the strongest correlation with infant mortality, in particular, dying in the first month of life. Particularly, it is believed that deficits in neurodevelopment, like learning disabilities and intellectual disability, are a significant contributor to infant and childhood morbidity.[3] Low birth weight causes the infant's growth to be stunted, which increases the risk of mortality, illness, impaired mental development and the development of chronic adult diseases. Neonatal mortality is four times more likely to happen in newborns who weigh 2,000-2,499 gms at time of birth than in those weighing 2,500-3,499 gms.[4]

Over 20 million underweight babies are born each year around the globe, or roughly 15.5 percent of overall births of live babies. Incidence rates for low birth weight vary greatly between industrialized and developing nations. 6% of infants with low birth weight take birth in impoverished nations, with 72% from Asia and 22% from Africa. More than twice as many cases of low birth weight occur in emerging nations (17%) than they do in industrialized regions (7%).[5] ccording to epidemiological findings, babies under the weight of 2500 gms have a 20-fold increased risk of death compared to bigger babies. This risk is directly linked to both prenatal and neonatal illness and death. Thirty to thirty-five percent of newborns born in India have low weight at birth and over fifty percent are full-term babies.[6]

Low birth weight has long been recognized as a significant sign of public health. Therefore, understanding the factors that influence low birth weight may be utilized to help develop low-resource public health initiatives that can enhance consequences of pregnancy and enhance the health of mothers and children.

METHODS

A community-based cross-sectional survey was conducted between June 2022 and July 2023, in Community Health Centre, Fatehganj Paschimi, Bareilly.

A literature search was done to get an existing prevalence of low birth weight. The prevalence for low birth weight was found to be 18% in Uttar Pradesh.[7] The sample size was calculated using the formula following, where p is the prevalence of low birth weight. Taking absolute precision as 5%, at 95% confidence level, the sample size was calculated using the following formula:

$N=[(Z^2\times p\times q)/d^2]$

where, n=sample size, Z=1.96 (95% CI), p=Prevalence of low birth weight (18 %) q=100-p, d=Absolute precision (which is taken as 5% in the current research).

$N=(1.96)^2\times(18)\times(82)/(0.05)^2$

The total sample size was calculated to be 227.

Inclusion criteria

Every mother giving birth to a single live newborn in the study place and mothers agreeing for the study.

Exclusion criteria

Mothers who refused to take part in the research and mothers of twins/triplets.

Within 24 hours of the birth, the weight of each baby were taken. Within 24 hours of giving birth, all mothers underwent examinations and interviews, and the results were documented. After 48 to 72 hours, the mothers whose condition did not allow for an inspection were inspected. Each mother's antenatal card and case sheet were thoroughly examined as they were all registered for prenatal treatment.

Statistical analysis

The information gathered from the filled-out surveys was manually entered into Microsoft Excel (Office 365 edition). For the variables, the data was suitably recoded. SPSS Version 21 was used to import the completed sheet. Frequencies and percentages were used to express the nominal outcome variables. Additional Chi-square analysis or Fisher's test was employed to ascertain a correlation between the category variables. Multivariate Logistic Regression was further applied to the statistically significant variables to identify factors associated with low birth weight.

RESULTS

Socio demographic characteristics of the study population

The prevalence of low birth weight (LBW) in the present study was found to be 20.3% (Figure 1). Of the 227 newborn babies, 122 (53.7%) babies were males and 105 (46.3%) babies were females. 24 (10.6%) babies were preterm deliveries, 201 (88.5%) babies were term deliveries and 2 (0.9%) babies were post term babies. Maternal education and monthly family income were found to be significantly associated with LBW (Table 1).

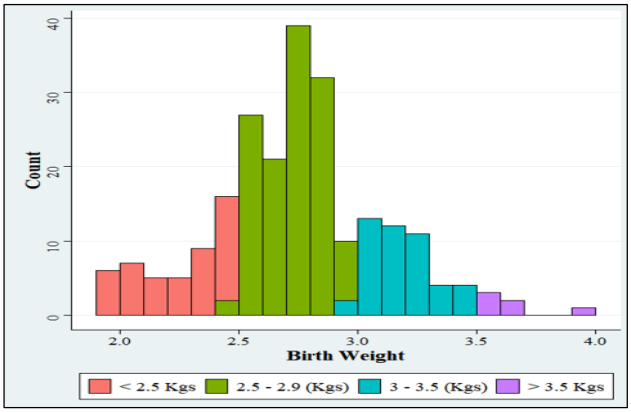

Figure 1: Histogram showing birth weight of babies, n=227.

Maternal clinical and natal characteristics

History of previous preterm delivery, maternal weight, maternal height and anaemia were found to be significantly associated with LBW (Table 2). Gestational length, number of Iron and folic acid tablets intake, weight gained during pregnancy and sex of baby were found to be significantly associated with LBW (Table 3).

Table 1: Socio-demographic characteristics of mothers, n=227.

Characteristics	Overall, n=227[1] (%)	LBW, n=46[1] (%)	NBW, n=181[1] (%)	P value
Age of mother (years)				
< 30	197 (86.78)	42 (91.30)	155 (85.64)	0.3[#]
≥ 30	30 (13.22)	4 (8.70)	26 (14.36)	
Place of residence				
Rural	191 (84.14)	39 (84.78)	152 (83.98)	0.9[#]
Urban	36 (15.86)	7 (15.22)	29 (16.02)	
Father's education				
Illiterate	58 (25.55)	17 (36.96)	41 (22.65)	0.14[#]
Primary school	131 (57.71)	22 (47.83)	109 (60.22)	
Secondary school and above	38 (16.74)	7 (15.22)	31 (17.13)	
Mother's education				
Illiterate	111 (48.90)	31 (67.39)	80 (44.20)	0.017[$]
Primary	109 (48.02)	14 (30.43)	95 (52.49)	
Secondary school and above	7 (3.08)	1 (2.17)	6 (3.31)	
Father's occupation				
Labourer	169 (74.45)	37 (80.43)	132 (72.93)	0.7[$]
Farmer	38 (16.74)	6 (13.04)	32 (17.68)	
Business/service	20 (8.81)	3 (6.52)	17 (9.39)	
Mother's occupation				
Non earning	219 (96.48)	45 (97.83)	174 (96.13)	>0.9[$]
Earning	8 (3.52)	1 (2.17)	7 (3.87)	
Religion				
Hindu	173 (76.21)	36 (78.26)	137 (75.69)	0.7[#]
Non-Hindu	54 (23.79)	10 (21.74)	44 (24.31)	
Type of family				
Joint	98 (43.17)	15 (32.61)	83 (45.86)	0.11[#]
Nuclear	129 (56.83)	31 (67.39)	98 (54.14)	
Monthly family income				
<20,000	155 (68.28)	39 (84.78)	116 (64.09)	0.022[#]
20,000-50,000	66 (29.07)	7 (15.22)	59 (32.6)	
>50,000	6 (2.64)	0.00	6 (3.31)	

[1]n (%); [#]Pearson's Chi-squared test; [$]Fisher's exact test

Table 2: Maternal clinical characteristics, n=227.

Characteristics	Overall, n=227[1] (%)	LBW, n=46[1] (%)	NBW, n=181[1] (%)	P value
Parity				
Primiparous	58 (25.55)	8 (17.39)	50 (27.62)	0.5[#]
1 live child	90 (39.65)	20 (43.48)	70 (38.67)	
2 live children	45 (19.82)	9 (19.57)	36 (19.89)	
>2 live children	34 (14.98)	9 (19.57)	25 (13.81)	
Abortion history				
Present	11 (4.85)	4 (8.70)	7 (3.87)	0.2[$]
Absent	216 (95.15)	42 (91.30)	174 (96.13)	
History of previous preterm delivery				
Present	6 (2.64)	5 (10.87)	1 (0.55)	0.001[$]
Absent	221 (97.36)	41 (89.13)	180 (99.45)	
Physical work during pregnancy				
Light	106 (46.70)	17 (36.96)	89 (49.17)	0.11[$]
Moderate	111 (48.90)	25 (54.35)	86 (47.51)	
Hard	10 (4.41)	4 (8.70)	6 (3.31)	
Maternal weight (kg)				
≥50	44 (19.38)	18 (39.13)	26 (14.36)	<0.001[#]

Continued.

Characteristics	Overall, n=227[1] (%)	LBW, n=46[1] (%)	NBW, n=181[1] (%)	P value
51-60	139 (61.23)	25 (54.35)	114 (62.98)	
>60	44 (19.38)	3 (6.52)	41 (22.65)	
Maternal height (cm)				
< 150	27 (11.89)	12 (26.09)	15 (8.29)	
150-155	86 (37.89)	19 (41.30)	67 (37.02)	0.005[#]
156-160	90 (39.65)	13 (28.26)	77 (42.54)	
>160	24 (10.57)	2 (4.35)	22 (12.15)	
Anemia				
No anemia	9 (3.96)	2 (4.35)	7 (3.87)	
Mild anemia	147 (64.76)	18 (39.13)	129 (71.27)	<0.001[$]
Moderate/severe anemia	71 (31.28)	26 (56.52)	45 (24.86)	

[1]n (%); [#] Pearson's Chi-squared test; [$] Fisher's exact test

Table 3: Natal characteristics, n=227.

Characteristics	Overall, n=227[1]	LBW, n=46[1]	NBW, n=181[1]	P value
Gestational length				
Preterm	24 (10.57)	21 (45.65)	3 (1.66)	<0.001[$]
Term	203 (89.43)	25 (54.35)	178 (98.34)	
Birth spacing				
<3 years	94 (41.41)	25 (54.35)	69 (38.12)	
> 3 years	75 (33.04)	13 (28.26)	62 (34.25)	0.12[#]
Primi	58 (25.55)	8 (17.39)	50 (27.62)	
No. of antenatal checkup visits				
Once	5 (2.20)	2 (4.35)	3 (1.66)	
Twice	54 (23.7)	14 (30.43)	40 (22.10)	0.11[$]
Thrice	107 (47.14)	23 (50)	84 (46.41)	
4 times or more	61 (26.87)	7 (15.22)	54 (29.83)	
Number of iron and folic acid tablets intake				
<100	91 (40.09)	29 (63.04)	62 (34.25)	<0.001[#]
>100	136 (59.91)	17 (36.96)	119 (65.75)	
Tetanus toxoid vaccine				
Taken required doses	161 (70.93)	31 (67.39)	130 (71.82)	0.6[#]
Missed doses	66 (29.07)	15 (32.61)	51 (28.18)	
Weight gain during pregnancy (Kg)				
<7	49 (21.59)	20 (43.48)	29 (16.02)	<0.001[#]
≥7	178 (78.41)	26 (56.52)	152 (83.98)	
Sex of baby				
Male	122 (53.74)	18 (39.13)	104 (57.46)	0.026[#]
Female	105 (46.26)	28 (60.87)	77 (42.54)	

[1]n (%); [#] Pearson's Chi-squared test; [$]Fisher's exact test.

Logistics regression analysis

Multivariate logistic regression analysis of the factors as per review of literature and p value <0.25 during bivariate analysis were taken for multivariable logistic regression.

In our study after adjustment, the odds for mothers aged 30 and above significantly increased the odds of normal birth weight ($p<0.05$). Mothers above 30 years are 12 times more likely to experience normal birth weight compared to those below 30. Primary education of mother is significant ($p<0.05$) suggesting that primary education of the mother decreases the odds of LBW compared to illiterate mothers.

Moderate work during pregnancy is significantly associated with increased risk of low birth weight ($p < 0.05$). Taking more than 100 Iron Folic Acid (IFA) supplements is highly significant ($p<0.01$), showing a strong association with normal birth weight. Term gestational length is a very strong predictor ($p<0.001$), with extremely high odds ratio of 96.50, indicating a very strong positive relationship between term gestational length and normal birth weight. Having a female baby is significantly associated with 3.57 times higher odds of LBW than male babies ($p<0.01$) (Figure 2) (Table 4).

Table 4: Logistic regression.

Variables	Crude Odd's Ratio [95% CI]	Adjusted Odd's Ratio [95% CI} Model 1	Adjusted Odd's Ratio [95% CI] Final Model
Intercept	-	0.00 [0.00, 0.72]	0.07 [0.01, 0.32]**
Age ≥30	1.76 [0.64, 6.21]	17.89 [2.20, 262.11]*	11.99 [1.80, 134.42]*
Primary education of mother	2.63 [1.33, 5.42]**	2.39 [1.10, 8.34]*	2.81 [1.10, 7.66]*
Secondary and above education of mother	1.84 [0.70, 5.25]	1.02 [0.02,111.33]	0.76 [0.08, 17.73]
Moderate work during pregnancy	0.66 [0.33, 1.29]	0.26 [0.06, 0.98]+	0.29 [0.10, 0.76]*
Hard work during pregnancy	0.29 [0.07, 1.22]	0.27 [0.03, 3.01]	0.18 [0.03, 1.26]+
Income ≥ 20,000	3.12 [1.40, 7.98]	2.45 [0.63,10.78]	2.20 [0.75, 7.40]
No. of IFA>100	3.27 [1.69, 6.53]***	4.97 [1.62,17.65]**	4.60 [1.84, 12.57]**
Term gestational length	49.8 [15.8, 222]***	97.39 [16.66, 855.62]***	96.50 [24.08, 551.74]***
Female baby	0.48 [0.24, 0.92]*	0.20 [0.06, 0.62]**	0.28[0.10, 0.69]**
Weight gain ≥7 kg	4.03 (1.99, 8.19)***	2.20 [0.62, 7.84]	-
Weight 51-60 kg	3.16 (1.50, 6.64)**	0.89 [0.21, 3.40]	-
Weight >60 kg	9.46 (2.86,43.3)***	1.65 [0.21, 15.71]	-
Height 150-155 cm	2.82 (1.12, 7.08)	3.82 [0.74, 20.10]	-
Height 156-160 cm	4.74 (1.82, 12.6)**	3.65 [0.68, 20.39]	-
Height >160 cm	8.80 (2.03,62.0)**	0.93 [0.10, 11.16]	-
AIC	-	177.0	153.0
BIC	-	283.2	187.3
Log likelihood	-	-57.502	-66.501
F	-	1.414	4.988
+p<0.1, *p<0.05, **p<0.01, ***p<0.001			

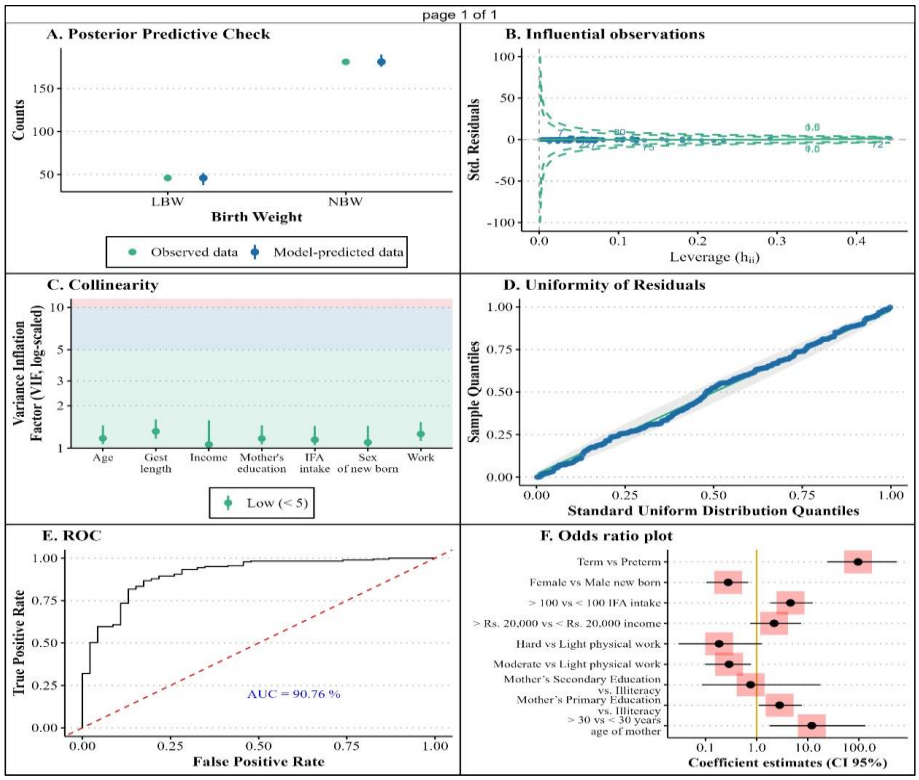

Figure 2: Diagnostic plots of a predictive model for birth outcomes. A, D) Showcasing model fit, B) Iinfluential data points, C) Collinearity, E) model performance, F) Predictor odds ratios with confidence intervals.

DISCUSSION

This study was carried out among 227 mothers and their newborns in a Community Health Centre, Bareilly, Uttar Pradesh to assess various factors associated with LBW.

The prevalence of low birth weight in the present study was found to be 20.3% that is above the national average of 18% while it was similar to the prevalence in Uttar Pradesh (20%).[7] So the findings could be generalised to a wider region. This emphasizes the importance of regional and context-specific health strategies to reduce the prevalence of low birth weight, aligning local efforts with broader national health goals.

We developed a predictable model which had 90% accuracy during ROC with AIC of 177 and log likelihood of -66.501.

In our study, mothers above 30 years are more likely to experience normal birth weight compared to those below 30 years which aligns with findings by other studies which also report findings of LBW to be common among younger mothers.[8,9]

Primary education of the mother was significantly associated with normal birth weight while secondary and above education did not show a significant effect in the final model in our study. This suggests that lower maternal education may increase vulnerability to adverse outcomes, potentially due to less access to health information and healthcare services and during pregnancy. The lack of significance for higher education could be due to small sample size or a more complex relationship with other variables such as socioeconomic status.[8]

In our study, moderate and hard work during pregnancy were significantly associated with LBW. Overexertion can lead to stress and fatigue which might impact fetal development.[8]

More than 100 IFA tablets consumed during pregnancy was a strong predictor of normal birth weight. This finding is in line with the importance of adequate nutrition and micronutrient supplementation in ensuring a healthy pregnancy and reducing complications. This underscores the importance of adequate IFA aupplementation during pregnancy.[8,11]

Term gestational length showed a very strong association with normal birth weight which is consistent with findings by other studies.[10] This result underscores the crucial role of a full-term pregnancy in achieving better neonatal and maternal outcomes. Preterm birth is a known risk factor for multiple complications, and this finding reaffirms the importance of preventing premature deliveries through early interventions and monitoring.

In our study, female babies have been observed to have higher chances of LBW. Our findings are consistent with other studies who have also noticed similar gender differences.[10,12]

Anthropometric indicators

Although significant associations were observed during bivariate analysis for maternal weight and height, these lost significance after adjustment, suggesting that factors like weight gain during pregnancy or other variables may play a larger role. In the final model, maternal height and weight did not appear to be strong independent predictors, which could indicate that while these are important factors, they are less influential when considered alongside other variables like nutrition, gestational age, and IFA intake.

The cross sectional nature of the study limits the ability to establish causality and it is also susceptible to recall and response bias. Further qualitative exploratory study is needed to assess the predictor variables in detail.

CONCLUSION

LBW was significantly associated with maternal age, maternal education, work during pregnancy, number of IFA tablets intake, gestational length and sex of the baby.

Low birth weight is one of the main factors influencing infant mortality in developing nations like India. Lowering the frequency of LBW has the potential to significantly improve pregnancy outcomes and decrease infant mortality. Planning of pregnancy should be the first step in any intervention aimed at lowering low birth weight. Consequently, our research suggests that in order to lower the percentage of LBW, teenagers should be made aware of importance of education and appropriate marriage age. Pregnant women should get health education on birth spacing, family planning, frequent prenatal checkups, iron and folic acid supplementation, and diet.

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